SiC Quantum Technology

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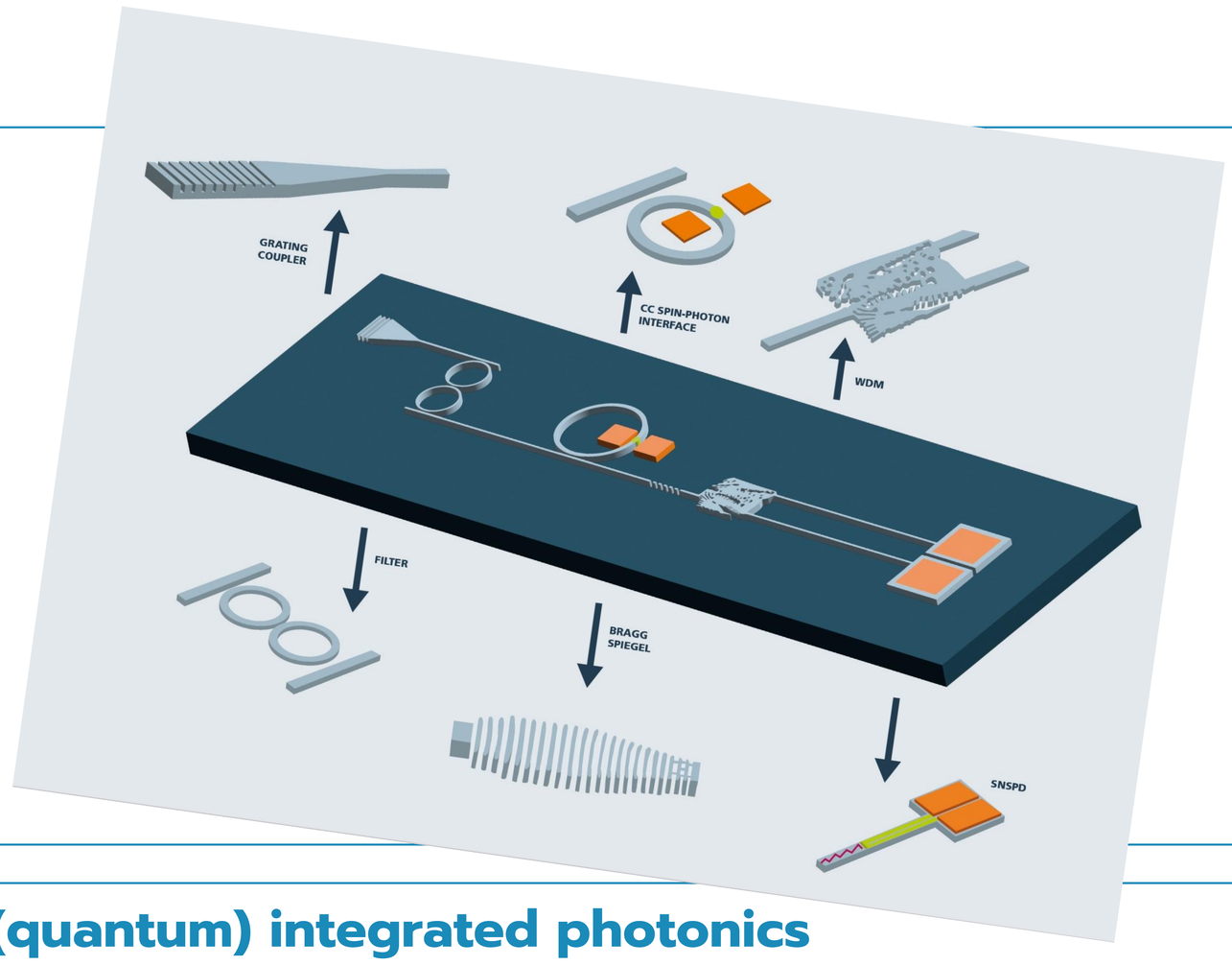
Overview

We use color center spin qubits for quantum computing, communication and sensing. SiC also facilitates electro-optic modulation (EOM) for QT and AI applications.

LEB/IISB stands for:
- CMOS compatible, standardized fabrication methods in 4H-SiC
- Coming soon: production line for Quantum activities

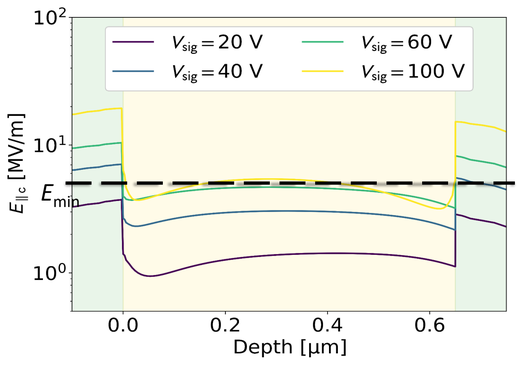
The TeQSiC Lighthouse Project extends the silicon carbide device technology towards quantum applications. This involves photonics integration and processing, simulation, substrate development and color center fabrication.

An international QuantERA project (SiCqurTech) will show a demonstrator for color center tuning on a-plane 4H-SiC by the integration of electronic and photonic structures on chip.

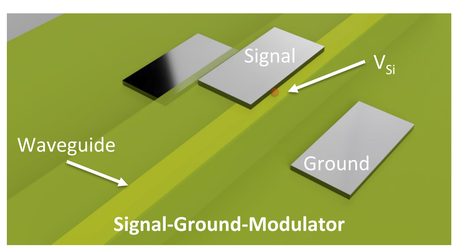


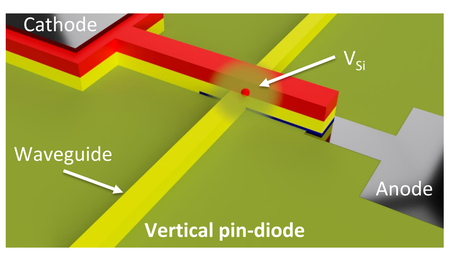
Novel device design for (quantum) integrated photonics

In **Signal-Ground-Modulators**, most of the electric field is concentrated across oxide cladding (green region in figure below)

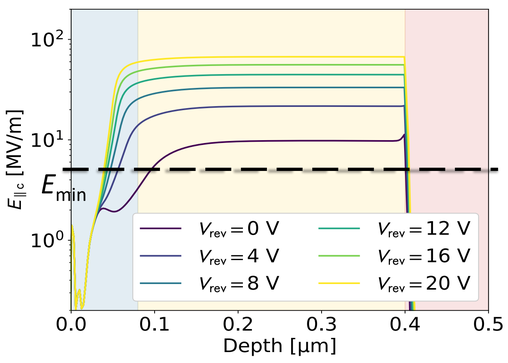


Maximum achievable electric field strength scales with waveguide height H and bandgap E_g due to **Fermi level pinning** at the interfaces

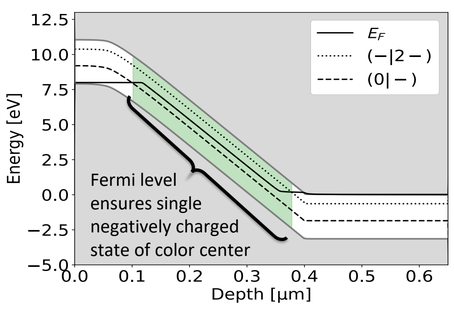




PIN-diodes have already shown promising results regarding V_{Si} Stark shift, charge state control and linewidth stabilization



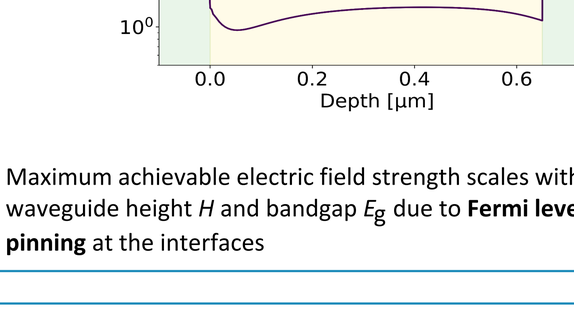
In thermal equilibrium the intrinsic layer of the pin-diode offers a wide region to host V_{Si} in optically active charge state (see green region below)



Shown above, the pin-diode **reaches the required field strength** in the intrinsic region (yellow) at **substantially lower voltages** than the signal-ground-modulator, making it more suitable for quantum photonic integrated circuits

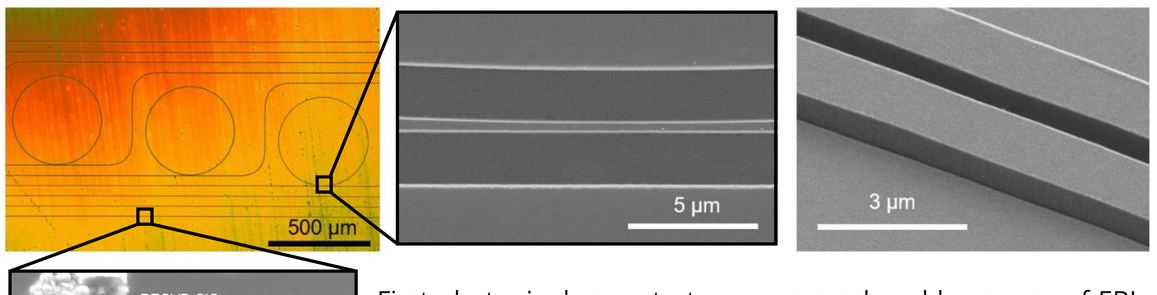
SiCOI chips for quantum photonic devices

Thin-film SiCOI substrates for quantum photonic device production is available. Fabrication scheme contains wafer bonding, grinding, CMP and RIE thinning

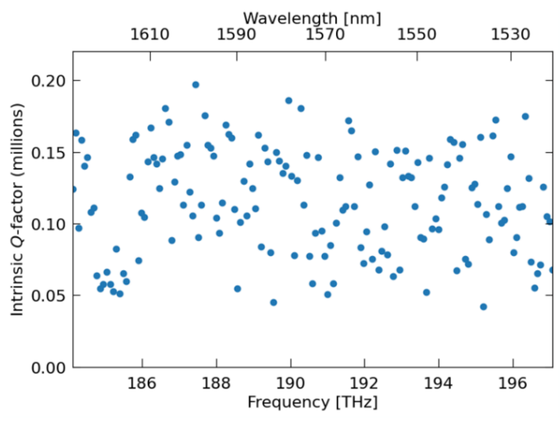


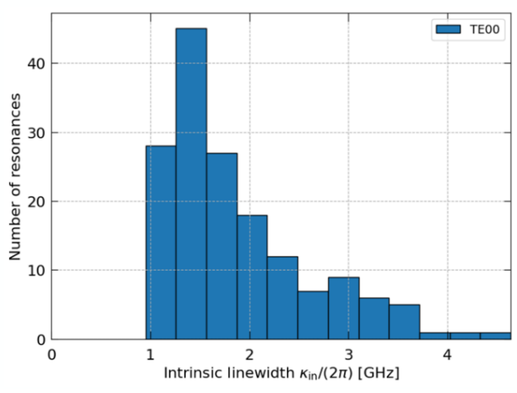


Fabrication of photonic devices



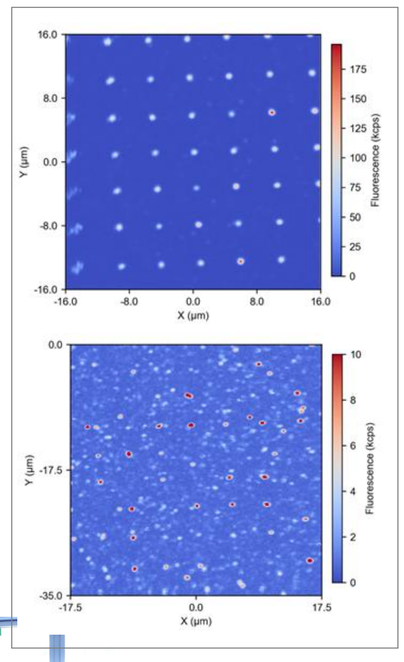
First photonic demonstrators were produced by means of EBL and RIE. Mean Q-factor of 115,000 with a most probable intrinsic line width of 1.26 GHz corresponding to 2.95 dB/cm.

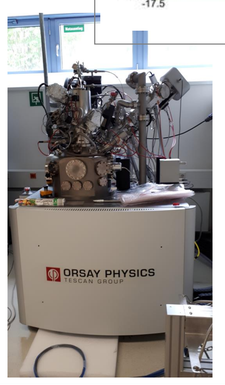




Pointwise creation of color centers

Focused Ion Beam (FIB) setup installed at IISB dedicated to pointwise fabrication of single color centers. Available ions are He, N, O, Au, Ge, Si. Tool also has SEM functionality and will be extended by a ToF-SIMS column.





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